The A. & M. College of Texas

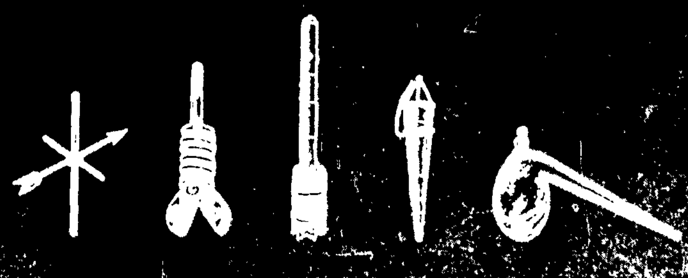
DEPARTMENT OF OCEANOGRAPHY

TRANSFER PROCESSES OPERATING AT THE OCEAN BOUNDARIES

Navy Department
Office of Naval Research
Contract N7 onr-48704

Project NR 083-071
Status Report
October 1953

SECOND ANNUAL REPORT



Research Conducted through the

Texas A. & M. Research Foundation

COLLEGE STATION, TEXAS

THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
Department of Oceanography
College Station, Texas

Research conducted through the
Texas A. & M. Research Foundation
in cooperation with the
Gulf Coast Producing Division
of the Pure Oil Company

Project 30

ANNUAL REPORT FOR

PERIOD ENDING APRIL 30, 1953

Project 30 is a study of transfer processes operating at the ocean boundaries sponsored by the Office of Naval Research (Project NR 083-071, Contract N7 onr-48704). Presentation of material in this report is not considered to constitute final publication.

Report Prepared
by
Robert O. Reid and William H. Clayton

October, 1953

TASK ORDER

The Contractor shall furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct a continuous observation and analysis program on the oceanography and meteorology of the Gulf of Mexico from a stationary platform. Such research shall include, but not necessarily be limited to:

(1) a continued series of observations of currents, waves, tides, winds, and sea and air temperatures, as well as temperatures in the bottom muds;

(2) an investigation of the processes operating in shallow water;

(3) development of the theoretical effects of wind stress on the water surface; and

(4) an evaluation of the effect of very high winds in shallow water with short fetches.

ABSTRACT

This report presents a summary of the general activities of ONR Contract N7 onr-48704, Project NR 083-071 for the contract year through April 30, 1953, as well as a brief summary of those activities being carried out and planned for the current contract year. The preliminary results of an investigation of the applicability of Prandtl's equation for determination of wind stress in the Atchafalaya Bay region from the vertical wind gradient, and a brief discussion of a study of the correlation of water level oscillations with barometric pressure and wind speed are presented.

Part I. ACTIVITIES DURING THE PERIOD 15 MARCH 1952 TO 30 APRIL 1953

INTRODUCTION

The primary aims of this project are to obtain serial measurements at a single station in a marine environment of those factors which are involved in ocean-atmosphere energy exchange, and to compare the behavior of these quantities with predictions based on the various existing theories concerning the transfer of heat, moisture, and momentum (stress) from or to the boundaries of the sea. Analysis during the contract period covered herein have been particularly directed towards studies concerned with the effects of wind stress and pressure upon the sea surface (momentum transfer). A phase of this study is reported in Part III of this report.

Until January 1953, the station from which the measuring program was conducted was a drilling platform approximately twelve miles off the Louisiana coast in Atchafalaya Bay. The use of this platform, owned by the Pure Oil Company, was first obtained by Texas A. & M. Research Foundation Project 25 (an oceanographic study of marine pipe line problems), in October of 1950. In June of 1951, the facilities of Project 25 were turned over to Project 30 and subsequently modified and expanded, as discussed in the first annual report.

A fire involving two of the five wells on the platform broke out in January of this year. The likelihood that this fire could be brought under control before the platform area would be destroyed was remote, and it was deemed advisable to dismantle the instrument station and get as much of the measuring gear off the platform as possible. This was done and very nearly all the instruments and supplies were safely removed.

The fire was brought under control without the platform on which the instruments were housed being destroyed by the fire. However, the damage to this platform was extensive; primarily as a consequence of back blast from a 75 mm tank rifle used to blow the tops off the burning wells and by the docking of fire fighting vessels adjacent to the platform. Had the station not been dismantled prior to these activities, the instrument program would have been almost a complete loss. That the evacuation of equipment was so successful is largely due to the efforts of the Pure Oil crew on duty at the time the fire began and the members of Coast Guard Vessel CG 56305. The former moved most of the recorders off the platform shortly after the fire began and stored them on one of their boats until A. & M. personnel could reach the site; the latter assisted in the removal of the remaining equipment and supplies and transported the whole to shore. Page 4 shows a few pictures of the fire at various stages.

While the project loss was slight in comparison to what it could have been, it was not negligible by any reckoning. Essentially all material of a fixed nature was destroyed or badly damaged. This included temperature and salinity lines, the catwalk structure, the weather shelter, the step gage, the wind instruments staff, and the mounting for the pressure wave head. The water level recorder and its still well were destroyed by the fire itself. This, added to the time required to re-establish the station, represented a setback of significant proportions.

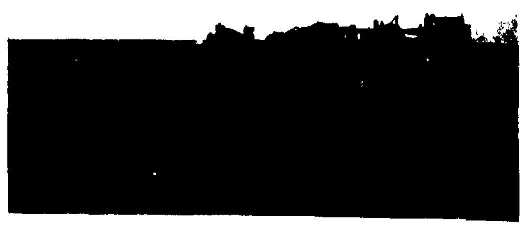
Even prior to the fire, some thought had been given to the possibilities of moving the instrument station to a different location along the Texas coast. The main reason behind such a move was the comparative isolation of the Louisiana location. A round trip of sixteen to twenty hours by road plus eight to ten hours by boat made weekend trips considerably inconvenient, yet were the only times that A. & M. personnel could visit the site during the academic year. This, coupled with the difficult task of securing a competent technician who would remain on the platform for extended periods, made a shift to a nearer location desirable if not imperative.

The fire settled this question. It was decided to shift to a more suitable site, if available, or discontinue the measuring program and confine project efforts to analysis of those data already collected.

A few sites were investigated and one was found that approximately satisfied all requirements. This was essentially the situation at the end of April 1953.

INSTRUMENTATION

This phase of the project did not change appreciably during the past



PICTURES DURING THE FIRE

year, but was improved by enlargement and modification of the instrument house and refinement of the existing measuring techniques at the Pure Oil platform prior to January 1953. The enlarged instrument house permitted better accommodation of the recording devices used by this project and Project 38 (a study of wave forces on hinged piling in shallow water, sponsored by Navy Department, Bureau of Yards and Docks). The instrument program of the latter project had been coordinated with that of Project 30 in June of 1952. The refinements introduced were primarily designed to allow establishment of routine standardization checks that could be done by a relatively unskilled observer.

The trial model of the step gage wave recorder developed on this project during the first contract year was replaced with an improved design in August 1952. Although this model was initially successful, water absorbtion by the insulating jacket between electrodes became significant after a short time. Different jacket materials were tried to eliminate this difficulty but none had proved satisfactory up to the time of the fire. As previously noted, the wave staff was severely damaged during the fire and has only recently been repaired.

A technical report on the step gage development is in preparation and it is expected that this will be ready for distribution in December 1953.

A pressure type wave recorder was installed at the Pure instrument site by personnel of Foundation Project 50 (a study of wave energy loss). Some records were obtained from this instrument prior to the dismantling of the station. These records have been analysed by personnel of Project 50, and some of the results are reported in a paper entitled "Surface Waves and Offshore Structures" (see Part IV).

Current measurements are still practically nil for the region. As indicated in the status report of December 1952, plans for a continuous recording meter were shelved for lack of funds. An indicating current device was designed and ready for field installation though not installed because of the fire.

GENERAL

The processing of data collected at the Atchafalaya site is near completion. With the exception of temperature records processing has kept pace with collection.

Analysis is directed along two major lines of investigation, the determination of wind stress upon the sea surface and changes in water level as associated with oscillations in barometric pressure and wind. Both phases are well under way and scheduled for more detailed coverage in technical reports to be issued at a later date.

Sections 1 through 3 of a four section data report (which will include all processed data collected at the Pure Oil platform up to the time the station was dismantled) have been sent to the full distribution list.

Typographical errors detected subsequent to the release of these sections are listed on a separate page accompanying this report.

Part II. ACTIVITIES DURING THE CURRENT CONTRACT PERIOD

THE NEW MEASUREMENT SITE

In April 1953 a suitable measurement site was found on the Texas coast and a request was made to the Texas A. & M. Research Foundation and the Office of Naval Research for approval to move to this new location. This approval was granted.

It was clearly evident at this stage that insufficient data had been collected for conclusive studies of transfer processes. For this reason practically all project effort was switched over to the task of setting up the new instrument program as the approaching summer period offered the only time of the year that would be advantageous for installation as far as personnel and weather were concerned.

By the latter part of May most of the plans for the new station were complete and work began. At the end of the summer period, the program was about three-quarters completed and it is anticipated that the remaining one-fourth, which is for the most part of an experimental nature, can be completed by January 1954. Some measurements have, at this date, already commenced (water level, radiation, air temperature, humidity, wind velocity, barometric pressure, waves).

The new site is on a pier belonging to the Sun Oil Company. It is located on Bolivar Peninsula about twenty miles east of Galveston, Texas, and a few miles west of Caplen, Texas. The overall length of the pier is just over one-half mile and extends from shore to a mean depth of about fifteen feet.

The advantages of the Caplen site over that of the Atchafalaya region are numerous. First of all, it is only four hours driving time by automobile from A. & M. to the actual instrument house. Not only does this cut driving time by more than half, it eliminates the boat trip and its attendant dependency on non-project activities. Also, this close proximity to A. & M. removes the problem of securing a technician to live at the site since project personnel from A. & M. can easily handle the program on weekly visits. This in turn means not only more reliable data but better continuity of those data. Some parameters that could not be measured at the old site can be measured at the new. Of particular consequence here are plans for measuring the wind induced slope of water surface for the calculation of wind stress. This will supplement, if not replace, the previous attempts to determine these stresses by measurement of vertical wind gradients. Finally, the exposure to waves from the open Gulf is better from the standpoint of measurements of the higher waves, which are of particular concern on related project work being undertaken at the same site. This is due primarily to the more suitable refraction effects in the region of Caplen and also the lesser loss of energy by bottom friction effects.

Almost all instrumental procedures at the new site will be modified to some degree in accordance with known needs. A complete description of these procedures will be given in the annual report for the current contract year.

Part III. SUMMARY OF INVESTIGATION OF WIND STRESS TO DATE

A. INVESTIGATION OF PRANDTL'S WIND PROFILE LAW FOR FLOW OVER A HYDRODYNAMICALLY ROUGH SURFACE

One of the objectives of this project concerns the evaluation of wind stress upon the sea surface for varying conditions of wind speed, atmospheric stability, and surface roughness. One approach to this problem is the measurement of the vertical gradient of horizontal wind speed from which wind stress may be estimated by use of any one of the several formulas theoretically relating wind speed and stress. The equation most generally accepted that relates these quantities for conditions of neutral stability of the air (adiabatic lapse rate) is

$$\bar{u} = \frac{u_*}{k_o} \ln \frac{z + z_o}{z_o} \quad , \tag{1}$$

* The symbol ln indicates logarithms to the base e , log indicates logarithms to the base 10.

where $\bar{u}$ — average wind speed at a level z above the surface,

u_*-- the "friction velocity" defined as the square root of the ratio of the tangential stress to the density of the fluid,

k_o-- von Kármán's coefficient for turbulent conditions (approximately 0.4 - dimensionless),

z_o-- a characteristic roughness parameter for a given surface (dimensions of length).

Equation 1 is derived from mixing length concepts first advanced by Prandtl and modified by Rossby and Montgomery(1) . This relation has been verified in a number of cases for flow over various types of land surfaces by several investigators.

Attempts to fit this distribution to flow over open ocean areas have not been numerous but some work has been done. Sverdrup(2) gives $z_o = 0.6$ cm. for the roughness parameter of the sea surface, the latter value being presumed to be independent of the wind velocity for flow over a rough surface under conditions of neutral stability. It appears that insufficient observations exist either to refute or to corroborate these findings and the above values should be considered as tentative. Sutton(3) evaluates the situation as follows: "...evidence gathered so far is not entirely consistent...a satisfactory account of air motion over the ocean has yet to emerge".

Wind measurements made by this project indicated that a logarithmic distribution of hourly mean speeds did not consistently occur. Thus, stress determinations by this method could not be made without further investigation of the validity of the application of equation 1 to the data. In fact, agreement with this distribution was so infrequent that it was deemed necessary to recheck all measurements in order to avoid the possibility of unreliable data. Any data that showed any likelihood of being suspect from the standpoint of sheltering or instrument malfunctioning were eliminated in this re-evaluation but with little change in the end results. The accepted data from which final analyses have been made are tabulated in Section 3 of a data report (December 1952) distributed by this project.

The earliest attempts to fit the observations collected on this project involved hourly and daily averages at four levels. However, due to the wide scatter of points, the curve fitting results were largely dependent on who did the fitting. Sight fitting was employed since the great number of cases made any other method prohibitively time consuming. All that could be clearly deduced from these attempts was that a logarithmic vertical wind gradient was the exception rather than the rule for hourly and daily average speeds.

All the observations listed in the above noted data report are hourly averages. The computations listed in this report are based on average values of those hourly measurements which are classified according to stability, direction, or speed without regard to simultaniety of observations at each level. That is, $\bar{u}_{16}$ in a given class may contain values for times at which u_8, u_{32}, or u_{64} was not measured. Consequently, the number of hourly values used per level from one class to the next may differ somewhat as do the number of observations used in computing the averages for the different levels within a given class. The overall period for these data is approximately one year. The pattern of deviation from the logarithmic distribution is not appreciably altered from that found previously using shorter time intervals and simultaneous readings at each level. However, the magnitudes of these variances of the large group averages are less and tend to approach moro nearly a logarithmic profile.

Equation 1 may be written as

$$(2) \qquad \bar{u} = \frac{u_*}{k_o} \ln (z + z_o) + \frac{u_*}{k_o} \ln 1/z_o \quad ,$$

which except for a very thin layer near the sea surface may be written as

$$(3) \qquad \bar{u} = \frac{u_*}{k_o} 2.30 \log z + \frac{u_*}{k_o} 2.30 \log 1/z_o \quad , z >> z_o \quad .$$

This in turn may be written as

$$(4) \qquad \bar{u} = A \log z + B \quad ,$$

where A and B are independent of z . The values of A and B will, of course, depend on the units employed for $\bar{u}$ and z , and will vary from case to case. Consequently, if this profile relation is valid, it should be possible to fit the observed data to a curve of the form of equation 4.

In order to insure that all curves be of the same weight as far as fit itself is concerned, the method of least squares was employed throughout. As noted earlier, computations involving overall averages are reported here. The sixteen representative cases are grouped according to stability, direction and speed. Taking the generally accepted value of 14-15 mph as being the transition speed between smooth and rough flow over the ocean, only those data for which $\bar{u}_{16} \geq 14$ mph are considered unless otherwise noted. The period covered by these data is October 1951 - August 1952. The reference levels are 8, 16, 32, 56 and 64 feet. Due to the comparatively few readings at 56 feet, these data are either ignored or included with the 64 foot data, depending on the number of readings for a given case.

Full details of measurement and processing can be found in the first annual report for this project.

From the definition of u_* given on page 10 it follows that:

(5) $$u_* = \sqrt{\tau/\rho} \quad ,$$

(6) $$\tau = \rho \gamma^2 \bar{u}^2 \quad ,$$

where γ^2 is the "resistance coefficient" (Taylor[4]), which is dimensionless. It follows from the foregoing equations that

$$u_* = \frac{Ak_o}{2.3} \quad ,$$

hence

(7) $$\tau = \rho \left(\frac{Ak_o}{2.3}\right)^2 \quad ,$$

and

(8) $$\gamma^2 = \left(\frac{u_*}{\bar{u}}\right)^2 = \left(\frac{k_o B}{\bar{u} \ln z_o}\right)^2 \quad .$$

Table 1 lists the values of mean speed for each level of each of the sixteen classes considered. The number of hourly mean speeds, upon which the class means at each level are based, are also given in the table. Table 2 lists the computed values of A , B , $\bar{u}_{10}$ (mean wind speed at the 10 meter level), z_0 , u_* , τ , and γ^2 . The value of k_0 was taken as 0.40. The values of A and B were evaluated from the data of Table 1 by the method of least squares, in which the sum of squares of the deviations of $\bar{u}$ from the regression line is minimized.

The fit of the logarithmic wind profile to the data is illustrated graphically for all sixteen cases on pages 20 through 24. On these graphs the circles represent the observed mean values for the class, and the straight line represents the theoretical logarithmic relation which best fits the data.

The question arises as to the statistical reliability of the values of γ^2 determined from the data at hand. The values of $\bar{u}$ obtained at each level for each class are merely sample values for the case considered. Because of the wide scatter of individual hourly values of speed for each level, it is evident that the relation between the values of mean speed at the different levels of a given class depends upon the number of hourly values used to estimate these mean speeds. Furthermore, the mean speeds at the different levels of a given class of data will not bear the same relation, one to the other, for different samples consisting of the same amount of data. That is, the slope of the best fit log curve to the data of a given class, and consequently the value of γ^2 for a given class, will vary depending upon the number of hourly observations and the sample of data chosen from that class. The reliability of the sample estimate of γ^2 for each class can be determined in terms of the standard deviation of the individual values of wind speed from the regression line fit according to methods outlined by Hoel[5]. Calculations based upon the present data indicate that the probable error in the individual values of γ^2 on the average is about $\pm 0.8 \times 10^{-3}$, and the 95 percent confidence limits are $\pm 2.4 \times 10^{-3}$. The overall mean γ^2 for the sixteen cases is 4.0×10^{-3} . The greatest value of γ^2 (case eleven) is 6.2×10^{-3} and the least is (case two) 1.9×10^{-3} . These represent deviations of 2.2×10^{-3} and -2.1×10^{-3} from the mean γ^2 . Consequently, these extreme values of γ^2 are therefore not significantly different, statistically speaking, from the overall mean γ^2 .

Thus, unless some physical basis for the variation in the sample values of γ^2 between cases can be advanced, the only conclusion that can be reached is that the value of γ^2 as ascertained from the present measurements is about 4.0×10^{-3} , subject to a probable error of $\pm 0.8 \times 10^{-3}$. Nothing can be definitely concluded at this stage with regard to the effect of stability, sea surface roughness, or wind direction in the area concerned. More observations would be required, so as to increase the statistical reliability of the sample estimates, before refinements of this nature could be made.

The values of z_o and γ^2 are greater than those arrived at by Rossby and Montgomery[1]. Also, if the variation of γ^2 with wind velocity has any significance in the present analysis, it would indicate a discrepancy with previous findings where the value of γ^2 tends to increase with increasing wind velocity [Keulegan[6], Van Dorn[7]]. It should be borne in mind, however, that the observations of wind velocity were restricted to levels of 8 feet (244 cm.) and greater above the mean sea level, and extended to 64 feet (1950 cm.). The range of levels examined by Van Dorn were 25 to 1000 cm., and those examined by Wüst (of whose data Rossby and Montgomery made extensive use) were 20 to 1000 cm. Furthermore, in most of the velocity profiles of Wüst and Van Dorn, the same type of consistent discrepancy from the logarithmic profile exists as with the data presented here. That is, the curves of $\bar{u}$ versus $\log z$ are convex towards the z-axis indicating a larger slope at the greater elevations. This implies actually that the stress increases with elevation and is not constant as presumed in the Prandtl-von Kármán theory.

In arriving at the value of z_0 and γ^2 of 0.6 and 2.6×10^{-3} from Wüst's data, Rossby and Montgomery made use of the 20 and 100 cm. levels only. Since the values of velocity reported here apply to levels well above 100 cm., and in view of the general trend of departure from the logarithmic profile at higher levels, it is not suprising that the values of z_0 and γ^2 as given in Table 2 are on the high side.

It should be further pointed out that the computations of γ depend directly upon the value of the von Kármán coefficient, k_0, and this value has been taken as that applicable to neutral stability. The present study does not afford any means of evaluating k_0 itself.

There is, of course, always the possibility of biased observations due to sheltering effects, differences in calibration of anemometers, and malfunctioning of the anemometers or recording equipment. All observations in the direction range from SW to NW where sheltering definitely existed were omitted in this study. Furthermore, the instruments were checked periodically to minimize malfunctioning and difference in calibration.

The results reported here are to be considered entirely of a preliminary nature. A considerable amount of analysis remains to be done with the wind data which has been collected. Furthermore, independent methods of evaluating the wind stress are to be investigated. One such method is through an analysis of the mean slope of the surface of the water under the action of the wind. Some preliminary work in this regard is reported in Section B.

References: (1) Rossby, C. G. and Montgomery, R. B., Papers in Phys. Ocn. and Met. Cambridge, Mass., 1935 3 p 3.

(2) Sverdrup, H. U., Journal of Met. 3 (1) 1946.

(3) Sutton, O. G., Micrometeorology, McGraw-Hill, N. Y. 1953 p 241.

(4) Taylor, G. S., Proc. Roy. Soc., London, 1916 p 197.

(5) Hoel, P. G., Introduction to Mathematical Statistics, John Wiley & Sons, Inc., New York, 1947 p 147-150.

(6) Keulegan, G. H., Wind Tides in Small Closed Channels, Journ. of Res. of the Nat. Bur. of Standards, Vol. 46, No. 5, May 1951 p 358-381.

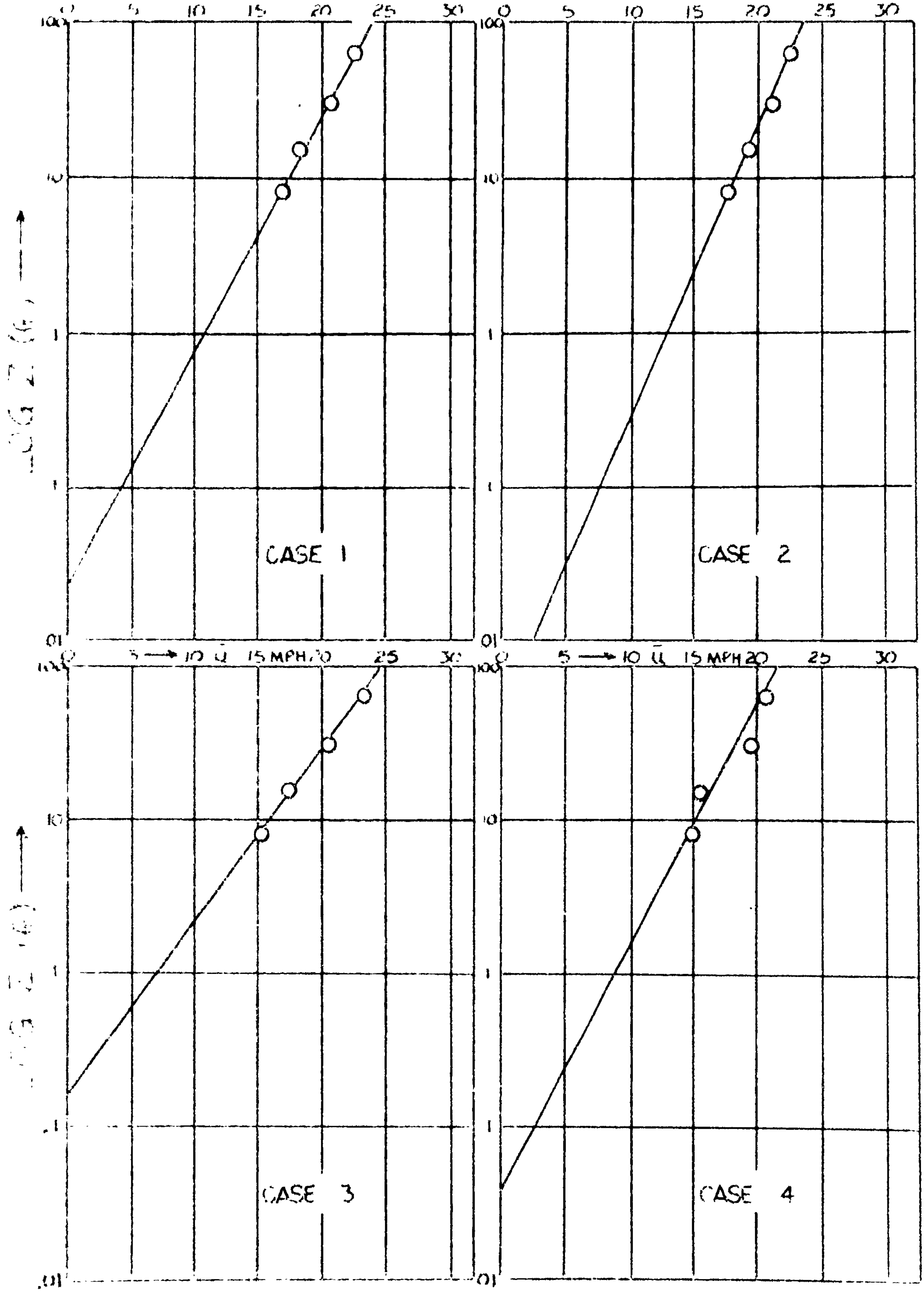
(7) Van Dorn, W. G., Wind Stress over Water, SIO Technical Report No. 52-60, Nov. 1952, 23 pp (unpublished).

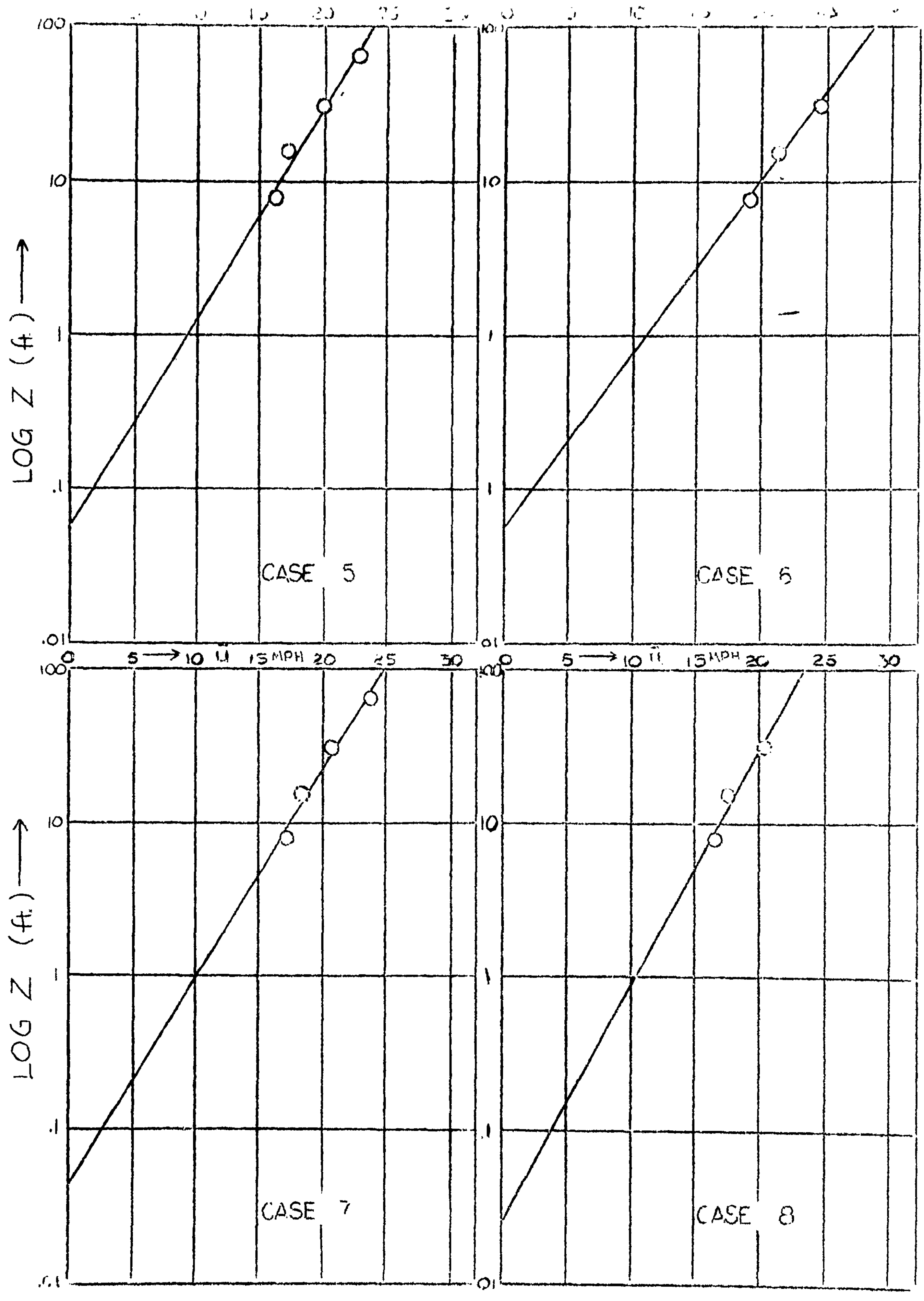
Case	$\bar{u}_8$	$\bar{u}_{16}$	$\bar{u}_{32}$	$\bar{u}_{64}$	# of readings at 8'	# of readings at 16'	# of readings at 32'	# of readings at 64'
1	7.53	8.07	9.22	10.05	359	508	518	188
2	7.89	8.58	9.39	9.99	242	249	249	81
3	6.83	7.76	9.16	10.37	89	208	230	89
4	6.69	6.97	8.73	9.17	28	51	39	44
5	7.24	7.69	8.92	10.12	359	508	518	345
6	8.56	9.53	10.92	-	21	21	21	0
7	7.69	8.22	9.25	10.59	200	320	342	242
8	7.34	7.85	9.12	-	102	114	113	0
9	6.60	6.97	8.39	9.21	30	47	42	48
10	6.63	7.08	-	8.86	6	6	0	6
11	4.64	4.89	6.01	7.04	415	609	583	544
12	5.82	6.16	7.21	8.43	284	388	363	304
13	7.07	7.58	8.74	10.09	136	211	211	163
14	8.10	8.92	10.13	11.83	72	91	89	47
15	9.49	10.42	11.38	13.02	62	83	79	37
16	11.49	13.01	14.48	-	10	10	10	0

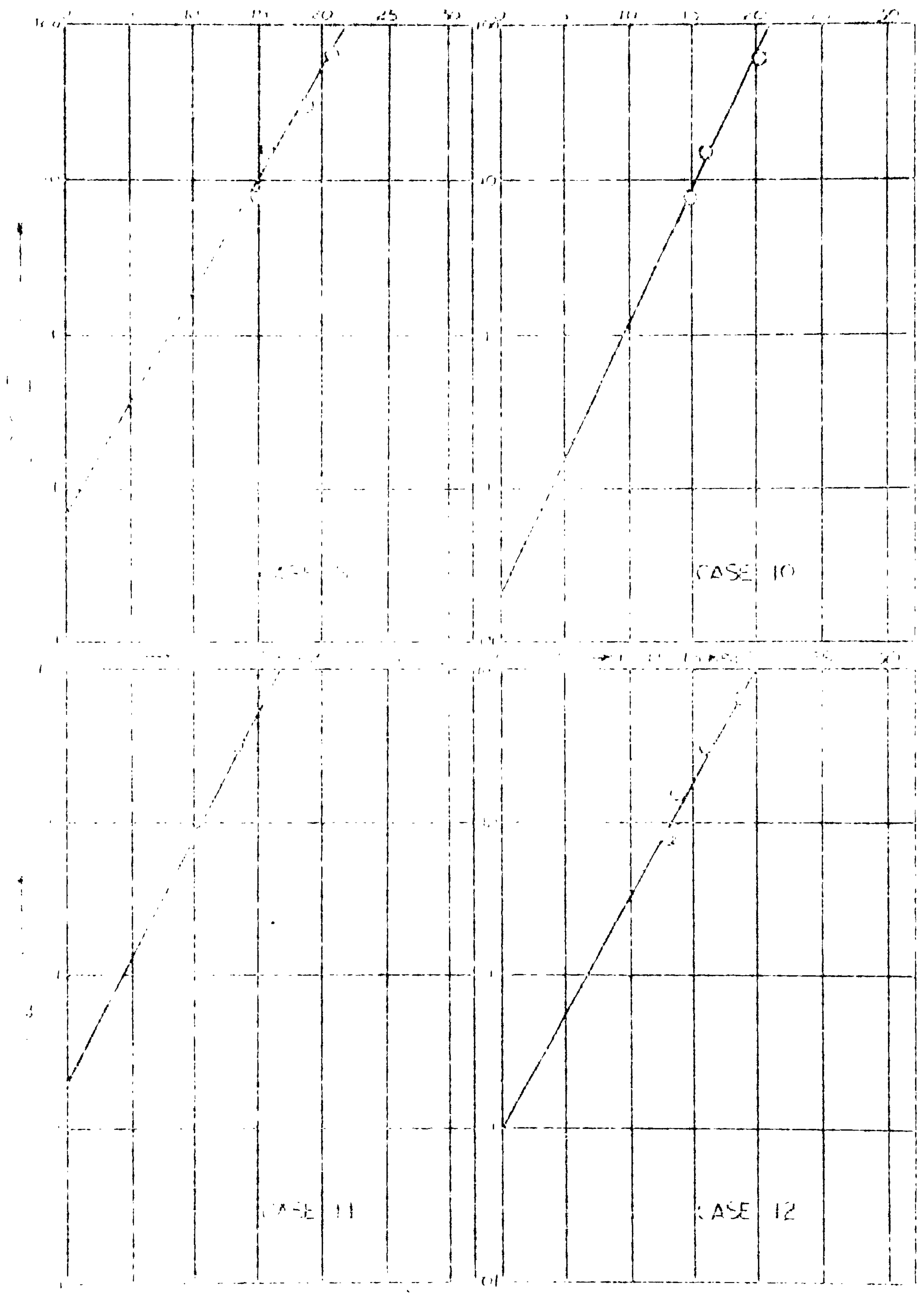
TABLE 1

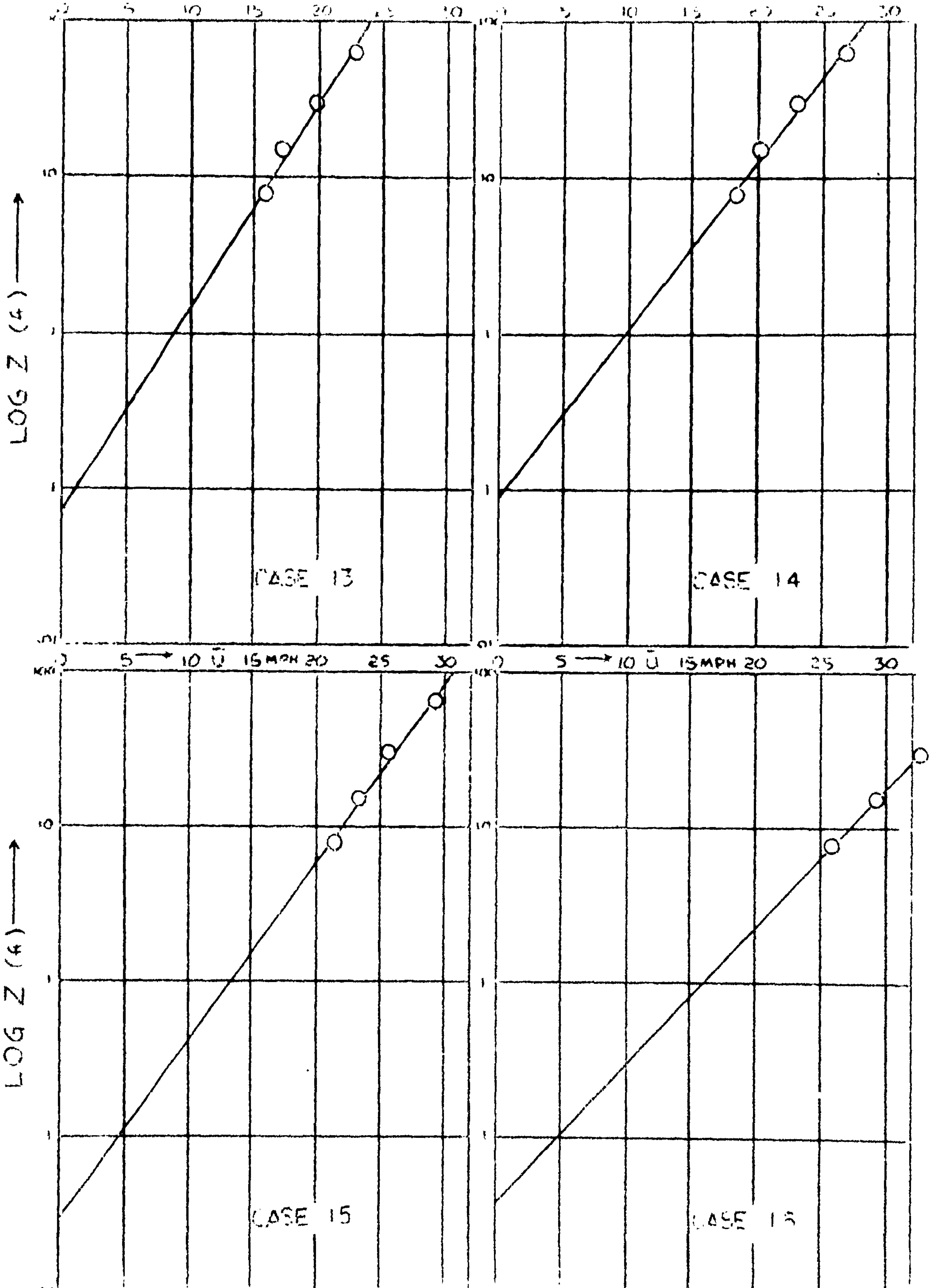
ase	Thermal Stability Index $T_a - T_w$ ^oF	U_{16} Speed Range meters/sec	Direction	A meters/sec	B meters/sec	z_o cm	$u_* = \frac{Ak_o}{2.3}$ meters/sec	$\tau = \rho u_*^2$ dynes/cm^2	$\bar{u}_{10}$ 1.52 A + B meters/sec	$\gamma^2 \times 10^3$ at 10 meters
1				2.89	4.80	0.7	0.51	3.30	9.20	3.0
2			northerly	2.37	5.77	0.1	0.41	2.13	9.37	1.9
3			easterly	3.98	3.13	5.0	0.69	6.03	9.18	5.6
4			southerly	2.82	3.98	1.2	0.49	3.04	8.26	3.5
5	weighted for neutral stability			3.28	4.05	1.8	0.57	4.12	9.03	4.0
6	-10 to - 6.1			3.93	4.93	1.7	0.68	5.86	10.90	4.0
7	- 6 to - 2.1			3.23	4.56	1.2	0.56	3.97	9.45	3.5
8	- 2 to 2			2.95	4.55	0.8	0.51	3.30	9.03	3.1
9	2.1 to 6			3.07	3.62	2.0	0.54	3.69	8.31	4.2
10	6.1 to 10			2.54	4.20	0.7	0.44	2.45	8.07	3.0
11		4.47 to 5.36		2.77	1.88	6.3	0.48	2.92	6.09	6.2
12		5.81 to 6.70		2.95	2.91	3.1	0.51	3.30	7.39	4.8
13		7.15 to 8.05		3.40	3.75	2.4	0.59	4.41	8.92	4.4
14		8.49 to 9.39		4.13	4.16	3.0	0.72	6.39	10.41	4.8
15		9.83 to 11.62		3.84	5.90	0.9	0.67	5.69	11.74	3.2
16		12.07 to 15.64		4.98	7.02	1.2	0.86	9.37	14.56	3.5

TABLE 2


CASE 1
CASE 2
CASE 3
CASE 4
→ U MPH


LOG Z (ft) ⟶
LOG Z (ft.) ⟶
100
10
1
.1
.01
0
5 ⟶ 10 u 15 MPH 20
25
30
CASE 5
CASE 6
CASE 7
CASE 8


CASE 10
CASE 11
CASE 12



LOG Z (4)
CASE 13
CASE 14
CASE 15
CASE 16
5 10 Ū 15 MPH 20 25 30

B. PRELIMINARY ANALYSIS OF WATER LEVEL DIFFERENCES BETWEEN PURE OIL PLATFORM AND EUGENE ISLAND

An analysis of the differences in daily mean water level between Pure structure and Eugene Island was made to see if any correlation with wind speed could be detected. The stations are approximately ten miles apart, and the mean depth is about ten feet. The water levels recorded at the two stations are not referred to the same reference, and consequently the absolute difference in levels cannot be ascertained with certainty. However, the changes in the water level differences (i.e. changes in the set up) can be detected and compared with changes in wind speed. The approximate difference in the reference levels between the stations was evaluated from the yearly mean water levels at the two stations, assuming that all wind effects during the year balance out on the average.

The components of wind speed along the line between the stations were plotted versus the water level difference, taking the estimate of the datum difference into account. However, the scatter of points was such that no consistent relation could be detected, except that the trend was for an upward slope in the direction of the wind as should be expected. It is felt that in the open water body concerned, the effect of atmospheric pressure gradients contribute significantly to the set up effect and are responsible for the low correlation between wind speed and set up alone. A more detailed analysis of both effects is to be carried out.

Part IV. REPORTS

PAPERS PRESENTED OR SCHEDULED FOR PRESENTATION AT NATIONAL MEETINGS WITHIN THE CURRENT PERIOD

The following papers represent results of research which has been partially supported by this project.

1. Wilson, B. W., "Generation of long period seiches in Table Bay, Cape Town, by barometric oscillations", presented at the May 1953 meeting of the American Geophysical Union in Washington, D. C. (This paper is in press).
2. Wilson, B. W., "Researches on harbor surging at Cape Town, South Africa", presented at the American Society of Limnology and Oceanography, September 1953, Madison, Wisconsin.
3. Wilson, B. W., "Table Bay as an oscillating basin", presented at the International Association of Hydraulic Research. This paper is reprinted from proceedings of the Minnesota International Hydraulics Convention, September 1-4, 1953, at Minneapolis, Minnesota.
4. Reid, R. O. and Bretschneider, C. L., "Surfaces waves and offshore structures", to be presented at the American Society of Civil Engineers in New York, October 22, 1953 (includes practical formulas for wind tide investigated on this project and results of wave studies from two other projects). Technical report issued October 20, 1953.
5. Bretschneider, C. L. and Reid, R. O., "Changes of wave height due to

friction percolation and refraction", presented at the American Geophysical Union meeting in Washington, D. C. in May 1953. (Being prepared for press).

PLANNED REPORTS FOR CURRENT PERIOD

1. Technical report on the development of a step-type wave recorder.
2. Annual Report (1953-54).

Section 4 of the data report should be ready for distribution in early 1954. This section will contain the remainer of those data collected at the Pure Oil platform.

CURRENT PROJECT PERSONNEL

Robert O. Reid	Project Supervisor
William H. Clayton	Associate in Oceanography
John E. Conner	Draftsman-Computer
Mary E. Gambill	Secretary-Computer
W. Dean McBride	Computer
Frank W. Moon	Research Assistant
Marian L. Proctor	Stenographer
Betty O. Robbins	Senior Computer
Basil W. Wilson	Associate Oceanographer

CORRECTIONS TO BE MADE IN SECTIONS 1 AND 2 OF DATA REPORT
(OCTOBER 6, 1953)

Section 1 - Temperature

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Air-Water Interface - Delete the following readings:

Date	Hour
May 3, 1952	1200 - Mean
May 6, 1952	0800 - Mean
May 8, 1952	1800 - 2200
May 10, 1952	1200
May 12-18, 1952	All

The mean reading for May 8, 1952 should be 83.0 rather than 82.7.

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1 Foot Above Bottom - March 2, 1951 - 1400-2200 readings should be 70.1, 70.3, 70.8, 70.8, 70.3 respectively, rather than 60.1, 60.3, 60.8, 60.8, 60.3.

March 3, 1951 - 0600 and 0800 readings should be 70.2 and 70.3 respectively, rather than 60.2 and 60.3. 1200 and 1400 readings should be 70.9 and 70.8 respectively, rather than 60.9 and 60.8.

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Water-Sediment Interface - May 15, 1951 - 0600 and 0800 readings should be 72.3 and 72.5 respectively, rather than 62.3 and 62.5.

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April 11, 1952 - 1600 reading should be 70.6 rather than 60.6.

Section 2 - <u>Water Level</u>

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June 14, 1952 - Readings for 1900-2300 inclusive are raw data rather than interpolated.